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1. Document ID: US 6681387 B1

L5: Entry 1 of 3

File: USPT

Jan 20, 2004

US-PAT-NO: 6681387

DOCUMENT-IDENTIFIER: US 6681387 B1

TITLE: Method and apparatus for instruction execution hot spot detection and monitoring in a data processing unit

DATE-ISSUED: January 20, 2004

INVENTOR-INFORMATION:

| NAME | CITY | STATE | ZIP CODE | COUNTRY |
|------------------------------|-----------|-------|----------|---------|
| Hwu; Wen-mei William | Champaign | IL | | |
| Merten; Matthew Carl | Champaign | IL | | |
| Trick; Andrew Raymond | Champaign | IL | | |
| George; Christopher Neith | Urbana | IL | | |
| Gyllenhaal; John Christopher | Livermore | CA | | |

US-CL-CURRENT: 717/158; 711/1, 712/234, 714/38, 717/127, 717/131

ABSTRACT:

Disclosed is a method and apparatus for detecting and monitoring program hot spots during execution that may be implemented in hardware. A hot spot detector tracks branch instructions which are retired. Frequently executed branch instruction addresses within a particular interval are designated as hot spot candidates. A hot spot detection counter is used to track non-hot spot branches and hot spot candidate branches. When hot spot candidate branches are frequently encountered compared to non-hot spot candidate branches, the hot spot detector may notify the operating system and hot spot candidate branch addresses may be supplied to a runtime optimizing compiler and a monitor table or a hot spot monitor. The hot spot monitor may disable the hot spot detector when a program is operating in known hot spots and may enable the hot spot detector if the program has strayed from known hot spots.

59 Claims, 5 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 5

 2. Document ID: US 6470492 B2

L5: Entry 2 of 3

File: USPT

Oct 22, 2002

US-PAT-NO: 6470492

DOCUMENT-IDENTIFIER: US 6470492 B2

TITLE: Low overhead speculative selection of hot traces in a caching dynamic translator

DATE-ISSUED: October 22, 2002

INVENTOR-INFORMATION:

| NAME | CITY | STATE | ZIP CODE | COUNTRY |
|---------------------|---------|-------|----------|---------|
| Bala; Vasanth | Sudbury | MA | | |
| Duesterwald; Evelyn | Boston | MA | | |

US-CL-CURRENT: 717/128

ABSTRACT:

A method and apparatus for selecting hot traces for translation and/or optimization is described in the context of a caching dynamic translator. The code cache stores hot traces. Profiling is done at locations that satisfy a start-of-trace condition, e.g., the targets of backward taken branches. A hot target of a backward taken branch is speculatively identified as the beginning of a hot trace, without the need to profile the blocks that make up the trace. The extent of the speculatively selected hot trace is determined by an end-of-trace condition, such as a backward taken branch or a number of interpreted or native instructions. The interpreter is augmented with a mode in which it emits native instructions that are cached. A trace is cached by identifying a hot start of a trace and then continuing interpretation while storing the emitted native instruction stream until an end-of-trace condition is met.

13 Claims, 3 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 3

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KOMC | Drawn D |
|------|-------|----------|-------|--------|----------------|------|-----------|-----------|-------------|--------|------|---------|
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 3. Document ID: US 6189141 B1

L5: Entry 3 of 3

File: USPT

Feb 13, 2001

US-PAT-NO: 6189141

DOCUMENT-IDENTIFIER: US 6189141 B1

TITLE: Control path evaluating trace designator with dynamically adjustable thresholds for activation of tracing for high (hot) activity and low (cold) activity of flow control

DATE-ISSUED: February 13, 2001

INVENTOR-INFORMATION:

| NAME | CITY | STATE | ZIP CODE | COUNTRY |
|------------------------|---------------|-------|----------|---------|
| Benitez; Manuel E. | Cupertino | CA | | |
| Mattson, Jr.; James S. | Campbell | CA | | |
| Buzbee; William B. | Half Moon Bay | CA | | |
| Shah; Lacky V. | Sunnyvale | CA | | |

US-CL-CURRENT: 717/153; 717/156, 717/158

ABSTRACT:

A computer-implemented system, method, and product are provided to designate and translate traces of original instructions of an executable file at run time based on dynamic evaluation of control flow through frequently executed traces of instructions. Such designation typically reduces unnecessary translations and optimizations, and thereby increases execution speed and reduces the usage of memory and other resources. The invention includes a hot trace identifier to identify frequently executed traces of instructions and a hot trace instrumenter to instrument such frequently executed traces so that control flow through them may be recorded. If the amount or rate of control flow through a frequently executed trace exceeds a threshold value, a hot trace selector is invoked to select a hot trace of original instructions including those of the frequently executed trace. The hot trace may be dynamically optimized. The system, method, and product also provide for the continuous recording of control flow through hot traces. If control flow has changed during execution, such that the amount or rate of control flow through a hot trace falls below a threshold value, the trace may be removed.

69 Claims, 15 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 13

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